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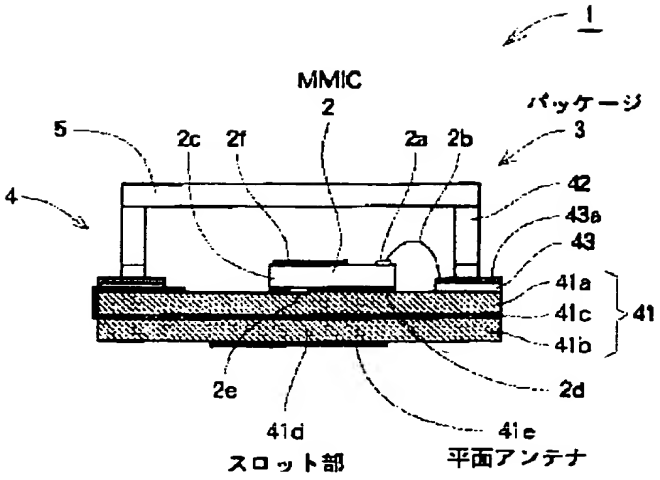
APPLICANT : HONDA MOTOR CO LTD;

INVENTOR : SHINGYOUCHI MASAHITO;

INT.CL. : H01P 5/08 H01L 23/04 H01Q 13/08 // G01S 7/03

TITLE : MMIC PACKAGE ASSEMBLY



ABSTRACT : PURPOSE: To prevent an undesired high frequency signal from entering a package or from being emitted to the outside of the package by coupling the inside of the package, an antenna element and a transmission line with each other electromagnetically through the use of slot coupling.

CONSTITUTION: A planar antenna 41e or a high frequency signal transmission line are formed to the rear side (outer lower face) of a package 3 containing an MMIC(monolithic microwave integrated circuit) 2 in an enclosing way and a ground conductor 41c provided with a rectangular slot section 41d is formed to the package 3. A microstrip line 2f is provided to the surface of the MMIC 2. The lengthwise direction of the slot section 41d is made orthogonal to the lengthwise direction of the microstrip line 2f. A high frequency signal is transmitted by electromagnetic coupling a planar antenna 41e or a high frequency signal transmission line with the microstrip line 2f via the slot section 41d.

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審査請求　未請求　請求項の数１　ＯＬ　（全８頁）

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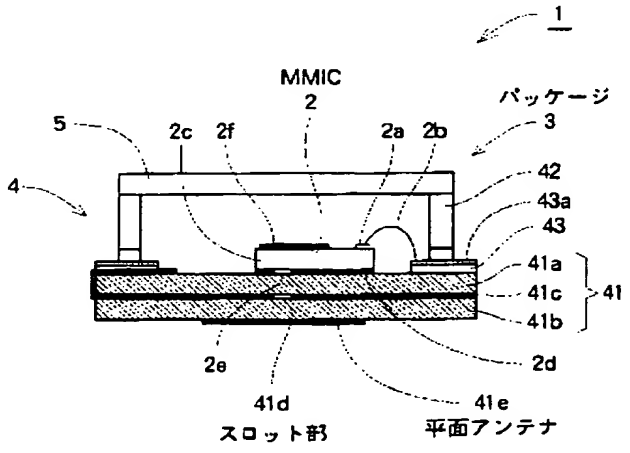
(54)【発明の名称】　ＭＭＩＣパッケージ組立

(57)【要約】

【目的】　スロット結合を利用してパッケージ内とアンテナ素子や伝送ラインとを電磁的に結合させることで、不要な高周波信号のパッケージ内混入やパッケージ外部への放射を防止した高信頼性構造のＭＭＩＣパッケージ組立を提供する。

【構成】　ＭＭＩＣ（モノリシックマイクロ波集積回路）２を密閉収容するパッケージ３の裏面（下側外面）に平面アンテナ４１ｅまたは高周波信号伝送ラインを形成するとともに、このパッケージ３に矩形状のスロット部４１ｄを備えた接地導体４１ｃを形成する。ＭＭＩＣ２の表面側にマイクロストリップライン２ｆを設ける。スロット部４１ｄの長手方向とマイクロストリップライン２ｆの長手方向が直交するよう配置する。平面アンテナ４１ｅまたは高周波信号伝送ラインとマイクロストリップライン２ｆとをスロット部４１ｄを介して電磁的に結合させて高周波信号を伝送する。



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【特許請求の範囲】

【請求項１】　ＭＭＩＣを密閉収容するパッケージの外面に平面アンテナまたは高周波信号伝送ラインを形成するとともに、前記パッケージにスロット部を備えた接地導体を形成し、前記パッケージ内に設けた入力または出力ラインと前記パッケージの外面に形成した平面アンテナまたは高周波信号伝送ラインとを前記スロット部を介して電磁的に結合させて高周波信号を伝送するようにしたことを特徴とするＭＭＩＣパッケージ組立。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、ＭＭＩＣ（モノリシックマイクロ波集積回路）を密閉封止したＭＭＩＣパッケージ組立に係り、特にパッケージの外面に形成した平面アンテナもしくは高周波伝送ラインとパッケージ内部の高周波信号ラインとをスロット結合を利用して電磁的に結合することで、不要な高周波信号の混入や輻射を防止するとともに、高信頼性の封止構造としたＭＭＩＣパッケージ組立に関する。

【０００２】

【従来の技術】社団法人　電子情報通信学会　信学技報Ａ・Ｐ９４－１４（１９９４－０５）Ｐ３７～Ｐ４３の「Ｋａ帯ＭＭＩＣを給電基板に用いたスロット結合マイクロストリップアンテナ」の論文には、以下の技術が記載されている。スロット結合マイクロストリップアンテナはアクティブアレーアンテナの有望な素子の１つである。Ｋａ帯・ミリ波帯などの高い周波数で用いる場合は給電損失を小さく抑えることが重要である。このため、ＭＭＩＣなどの能動回路そのものを給電基板とする構造が有効である。しかしながら、接地導体板の導体が銅箔やＭＭＩＣの裏面に蒸着された金（Ａｕ）などのミクロン単位の薄いものを使用している場合、機械的強度と排熱効果が不充分である。

【０００３】機械的強度と排熱効果の課題を解決するため接地導体を厚くしても所望のアンテナ特性が得られるようにしたスロット結合マイクロストリップアンテナは、特開平６－９７７２４号公報で提案されている。また、特開平６－９７７２４号公報では、スロット内を通過する高周波信号と他のマイクロストリップ導体との結合をなくすため、貫通スロットの内面に接地導体を形成する技術が提案されている。

【０００４】図１２は前述の論文の図７に記載された従来のスロット結合マイクロストリップアンテナの模式構造図である。図１２（ａ）は試作アンテナのＭＭＩＣ配置を、図１２（ｂ）はスロット断面を示す。このスロット結合マイクロストリップアンテナ１００は、接地導体板を３層に分け、スロット長を３段に分割した構造になっている。第１および第２の接地導体板１０１，１０２がＭＭＩＣ１０４のチップキャリア部分を成し、第３の接地導体板１０３がインピーダンス整合用という構造に

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なっている。このような構造にすることで、チップ単体では取り扱いが困難なＭＭＩＣを電源線路の引き出し配線のみで簡便に取り扱え、スロット長の調整も容易になるとしている。なお、矩形のパッチ放射体（パッチアンテナ）１０５は、放射基板１０６の上に形成されている。符号１０７は給電用のマイクロストリップラインである。

【０００５】しかしながら、図１２に示したスロット結合マイクロストリップアンテナ１００は、試作評価用のためＭＭＩＣ１０４はむき出しであり、実用化するにはＭＭＩＣをセラミック等のパッケージ内に密封する必要がある。

【０００６】特開平１－３１０５７２号公報では、アンテナ素子とＭＭＩＣとを同一容器内に密閉したマイクロ波集積回路が提案されている。図１３は特開平１－３１０５７２号公報の１図に記載されたマイクロ波集積回路の断面図である。この従来のマイクロ波集積回路２００は、アンテナ素子２０１と、ＭＭＩＣチップからなる増幅回路２０２と、複数の端子２０３と、密閉容器（以下ケースと記す）２０４とから構成されており、ケース２０４の内側は輻射開口部２０５と端子２０３の付近を除いて全て紫外線保護と電磁シールドの為に、例えばメタライズ等による金属膜または金属２０６が施されている。輻射開口部２０５は、例えばガラスまたはセラミックスの如き電波を通過し気密性を保持する物質で構成しており、外部からこの輻射開口部２０５を通過した信号はアンテナ素子２０１によって受信され、ボンディングワイア２０７へ経てＭＭＩＣチップからなる増幅回路２０２で増幅・周波数変換されてボンディングワイア２０８を経て端子２０３から出力される。

【０００７】

【発明が解決しようとする課題】前述したように、図１２に示したスロット結合マイクロストリップアンテナ１００は、試作評価用のためＭＭＩＣ１０４はむき出しであり、実用化するにはＭＭＩＣをセラミック等のパッケージ内に密封する必要がある。図１３に示したように、アンテナ素子２０１とＭＭＩＣ２０２とをケース２０４を密閉する場合は、電波を通過させるための輻射開口部２０５を形成しなければならない。しかしながら、輻射開口部２０５を設けると、この輻射開口部２０５からパッケージ（ケース）内に不要な高周波信号が混入したり、パッケージ内から不要な高周波信号が外部へ放射されてしまうことがある。

【０００８】この発明はこのような課題を解決するためなされたもので、ＭＭＩＣをパッケージ内に気密封止するとともに、そのパッケージの外面にアンテナ素子や高周波信号の伝送ラインを形成し、スロット結合を利用してパッケージ内とアンテナ素子や伝送ラインとを電磁的に結合させることで、不要な高周波信号のパッケージ内混入やパッケージ外部への放射を防止した高信頼性構造

のＭＭＩＣパッケージ組立を提供することを目的とする。

【０００９】

【課題を解決するための手段】前記課題を解決するためこの発明に係るＭＭＩＣパッケージ組立は、ＭＭＩＣを密閉収容するパッケージの外面に平面アンテナまたは高周波信号伝送ラインを形成するとともに、このパッケージにスロット部を備えた接地導体を形成し、パッケージ内に設けた入力または出力ラインとパッケージの外面に形成した平面アンテナまたは高周波信号伝送ラインとをスロット部を介して電磁的に結合させて高周波信号を伝送するようにしたことを特徴とする。

【００１０】

【作用】パッケージの外面に形成された平面アンテナまたは高周波信号伝送ラインとパッケージ内に設けた入力ラインまたは出力ラインとは、接地導体のスロット部を介してスロット結合する構造としたので、電磁結合によって例えばＭＭＩＣの高周波出力信号を平面アンテナへ給電し電波を放射させたり、平面アンテナで受信した高周波信号を電磁結合によってパッケージ内部のＭＭＩＣへ供給することができる。また、平面アンテナの代りに高周波伝送ラインを形成することで、パッケージ内の出力信号を外部へ供給したり、外部からの高周波信号をパッケージ内のＭＭＩＣへ供給することができる。

【００１１】電磁結合を行なうスロット部以外は接地導体とすることができるので、不要な高周波信号がパッケージ内部へ混入したり、パッケージ内から不要な高周波信号がパッケージ外へ放射されるのを効果的に防止できる。

【００１２】

【実施例】以下この発明の実施例を添付図面に基づいて説明する。図１はこの発明に係るＭＭＩＣパッケージ組立の模式縦断面図、図２はパッケージの蓋体を外した状態の斜視図、図３は端子ブロックの斜視図、図４はパッケージを裏面側から見た斜視図、図５はＭＭＩＣの模式平面図、図６はマイクロストリップラインとスロット部と平面アンテナの位置関係を示す模式平面説明図である。

【００１３】図１に示すようにこの発明に係るＭＭＩＣパッケージ組立１は、ＭＭＩＣ（モノリシックマイクロ波集積回路）２をパッケージ３内に密閉収容してなる。パッケージ３は、基体４に蓋体５をハーメチックシールしてなる。

【００１４】図２に示すように、基体４は、ベース４１とフレーム４２と複数の端子ブロック４３とを一体的に形成してなる。図１に示すように、ベース４１は、上下の誘電体板（例えばセラミック板）４１ａ，４１ｂと、それらの間に挟設された接地導体４１ｃとの３層からなる。接地導体４１ｃは、矩形状のスロット部４１ｄを備える。接地導体４１ｃは、導体板を加工して形成してもよいし、上または下の誘電体板４１ａ，４１ｂに導電性材料を蒸着等して形成してもよい。

【００１５】図４に示すように、下側の誘電体板４１ｂの下面側（パッケージの外面側）には、例えば矩形状の平面アンテナ（放射導体）４１ｅを設けている。平面アンテナ（放射導体）４１ｅは、金属板もしくは金属箔を貼り付けて形成してもよいし、導電性材料を蒸着等して形成してもよい。

【００１６】フレーム４２は金属等の導電性材料を用い、図２に示すように枠状に形成してなる。フレーム４２は、端子ブロック４３を設けるための切欠き部４２ａを備える。図３に示すように、端子ブロック４３は、導電性のリード部４３ａを備えたセラミック製の端子板４３ｂと、セラミック製の絶縁ブロック４３ｃとからなる。図２に示すように、複数のリード部４３ａを備えた端子ブロック４３と、単一のリード部４３ａを備えた端子ブロック４３ａとを直角に配置し、複数のリード部４３ａを備えた端子ブロック４３を電源供給用、単一のリード部４３ａを備えた端子ブロック４３を高周波信号の入出力用とすることで、高周波信号が電源系統へ混入しにくい構造としている。

【００１７】図１に示すように、接地導体４１ｃを上側の誘電体板４１ｂの側面から上面へ延設し、延設した接地導体４１ｃと例えば金属製のフレーム４２とを電気的に接続する構造としてもよい。なお、図１では、特定の辺に対して接地導体４１ｃを延設する例を示したが、４辺すべてについて接地導体を延設するようにしてもよい。

【００１８】蓋体５はセラミック板もしくは導電性材料で形成している。蓋体５は、セラミック板の下面（パッケージの内面側）に導電性金属を蒸着する構造としてもよい。蓋体５を導電性の構造とし、フレーム４２に蓋体５を気密封止した状態で、金属製のフレームと蓋体５とが電気的に接続する構造とすることで、入出力用の端子ブロック４３の部分を除いて、パッケージ３の６面を電磁シールド構造とすることができる。このような構造とすることで、不要信号の混入やパッケージ内部から不要な高周波信号が放射されるのを効果的に防止できる。

【００１９】図１に示すように、パッケージ３内に固着されたＭＭＩＣ２の取出電極２ａと端子ブロック４３のリード部４３ａとの間は、ボンディングワイヤ２ｂで電気的に接続している。ＭＭＩＣ２は、例えばＧａＡｓ等の半絶縁性の基板２ｃに各種の回路素子を形成している。基板２ｃの裏面には接地金属２ｄを形成している。この接地金属２ｄには、金属を設けない例えば矩形状のスロット部２ｅを備える。ＭＭＩＣ２の上面側にマイクロストリップライン（マイクロストリップ導体）２ｆを設けている。

【００２０】図５に示すように、マイクロストリップライン（マイクロストリップ導体）２ｆの一端側は、基板

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２ｃの表面側に形成された例えば送信用高周波出力トランジスタ２ｇの出力端子２ｈや受信回路の初段回路等へ接続している。基板２ｃの裏面側に形成したスロット部２ｅの長手方向と、マイクロストリップライン２ｆの長手方向とは直交する配置としている。

【００２１】図６に示すように、パッケージ３の外面に形成した平面アンテナ４１ｅの略中央位置にマイクロストリップライン２ｃが位置するようにし、図１に示した上下２層の誘電体板４１ａ，４１ｂにサンドイッチされた接地導体４１ｃに、矩形状のスロット部４１ｃをその長手方向がマイクロストリップライン２ｆの長手方向と直交するよう形成している。

【００２２】したがって、基板２ｃの表面側に形成したマイクロストリップライン２ｆと、パッケージ３の裏面に形成した平面アンテナ４１ｅとの間には、基板２ｃの裏面に形成した第１のスロット部２ｅと、パッケージ３のベース４１内に形成された第２のスロット部４１ｄが所定の位置関係で配置される。

【００２３】このような構造において、マイクロストリップライン２ｆに例えば高周波送信信号を給電したとき、マイクロストリップライン２ｆから２段のスロット部２ｅ，４１ｄを介して平面アンテナ４１ｅを励振し、高周波送信信号に対応する電磁波が平面アンテナ４１ｅの表面に対して垂直な方向に放射される。パッケージ３の外面に設けた平面アンテナ４１ｅとパッケージ３の内部とを電磁結合する２段のスロット部２ｅ，４１ｄ以外ならびに端子ブロック４３以外は、パッケージ３の全面に亘って接地導体とすることができるので、不要な高周波信号がパッケージ内部へ混入したり、パッケージ内から不要な高周波信号がパッケージ外へ放射されるのを効果的に防止できる。

【００２４】図７はこの発明に係るＭＭＩＣパッケージ組立の他の実施例を示す模式縦断面図である。図７に示すＭＭＩＣパッケージ組立１０は、ＭＭＩＣ２の基板２ｃの裏面側に接地金属２ｄを設けないスロット部２ｅを形成し、このスロット部２ｅを介して基板２ｃの表面側に形成したマイクロストリップライン２ｆとパッケージ３の底面に形成した平面アンテナ４１ｅとを電磁的に結合させるようにしたものである。この１段スロット構成においては、パッケージ３のベース４１Ｓに図１で示した接地導体４１ｃならびにスロット部４１ｄを形成する必要がない。このため、例えばセラミックス製の標準的なベース４１Ｓに平面アンテナ４１ｅを蒸着等で形成するだけでよく、パッケージ組立１０を安価にできる。また、基板２ｃの略中央部にスロット部２ｅを形成することで、スロット部２ｅの周辺の接地領域の広さをほぼ均一し、電磁結合特性の安定化を図っている。

【００２５】図８はこの発明に係るＭＭＩＣパッケージ組立の第３の実施例を示す模式縦断面図である。図８に示すＭＭＩＣパッケージ組立２０は、金属製のパッケージ３０内に、ＭＭＩＣ２を密閉収容したものである。パッケージ３０は、金属製の基体３１に金属製の蓋体３２をハーメチックシールしてなる。基体３１には、平面視矩形状の透孔からなるスロット部３１ａを形成し、このスロット部３１ａを例えばセラミック製の誘電体塞板３３で塞ぐことで、パッケージ３０内の気密を保つようにしている。そして、誘電体塞板３３の底面に平面アンテナ４１ｅを形成し、平面アンテナ４１ｅとＭＭＩＣ２の表面側に形成したマイクロストリップライン２ｆとをスロット部３１ａを介して電磁的に結合させている。パッケージ３０の全体が金属製であるから、不要信号の混入やパッケージ内部から不要な高周波信号が放射されるのを効果的に防止できる。

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【００２６】図９はこの発明に係るＭＭＩＣパッケージ組立を利用して構成した車載用レーダモジュールのブロック構成図である。パッケージ６０の底面もしくは上面（側面であってもよい）６０ａは、スロット部６０ｂを備えた接地導体６０ｃを２層のセラミック板６０ｄ，６０ｅで挟設し、各端子ブロック６０ｆ，６０ｇ，６０ｈ，６０ｉの部分を除いてパッケージ６０の他の面は金属もしくは導体層を蒸着等したセラミックで形成し、パッケージ６０の全体を電磁シールドする構造としている。

【００２７】パッケージ６０の内部には、例えば数１０ギガヘルツ帯の高周波信号を処理する例えばＧａＡｓチップからなるＭＭＩＣ７０と、ギガヘルツ帯よりも低い周波数の信号を処理する例えばＳｉチップからなるアナログ・デジタル信号処理ＩＣ８０とを密封収容している。端子ブロック６０ｇならびに端子ブロック６０ｉを介して正負の電源Ｖ＋，Ｖ－の供給を受けるようにしている。

【００２８】パッケージ６０の底面もしくは上面（側面であってもよい）６０ａの外面側に平面アンテナ６３を形成し、内面側にマイクロストリップライン（マイクロストリップ導体）６４を形成している。

【００２９】マイクロストリップライン６４と送受切換手段７１との間は、ボンディングワイヤ６４ａで接続している。ＭＭＩＣ７０に裏面にマイクロストリップライン６４を形成し、バイアホール等を介してマイクロストリップライン６４と送受切換手段７１とを接続する構造としてもよい。

【００３０】送受切換手段７１は、サーキュレータ回路やスイッチ回路を用いて構成している。受信信号７１ａを低雑音増幅器７２で増幅し、帯域通過フィルタ（ＢＰＦ）７３を介して所望の周波数帯域の信号成分を抽出し、混合器（ミキサ）７４で端子ブロック（外部接続端子）６０ｆを介して外部から供給される局部発振信号７４ａと混合して周波数変換して得た中間周波信号７４ｂをアナログ・デジタル信号処理ＩＣ８０内の中間周波増幅回路（ＩＦ増幅回路）８１へ供給している。

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【００３１】なお、端子ブロック（外部接続端子）６０ｆを設けずにパッケージ６０の一側面にスリット結合を設けて、局部発振信号７４ａを電磁結合でパッケージ６０内に供給するようにしてもよい。

【００３２】中間周波信号７４ｂを中間周波増幅回路８１で増幅した後、Ａ／Ｄ変換器でデジタル中間周波信号へ変換し、マイクロプロセッサを利用して構成した処理手段８３でデジタル信号処理を施すことで受信信号を解析し、ターゲットまでの距離情報等を外部へシリアルデータ８３ａとして出力するようにしている。

【００３３】処理手段８３から出力された変調指令８３ｂをＤ／Ａ変換器８４で対応するアナログ信号（例えば電圧信号）８４ａへ変換し、ＭＭＩＣ７０内の変調器７５へ供給し、変調信号７５ａを高周波増幅器７６で増幅し、位相器７７で位相調整をした後に高周波電力増幅器７８で電力増幅し、送受切換手段７１を介して給電用のマイクロストリップライン６４を励振し、スロット結合を介して平面アンテナ６３からレーダ電波を放射するようにしている。

【００３４】このように発明に係るＭＭＩＣパッケージ組立を利用して構成した車載用レーダモジュールは、スロット結合を利用して平面アンテナ６３からの電波放射と反射波の受信を行なうようにしている。スロット部６０ｂならびに各端子ブロック６０ｆ，６０ｇ，６０ｈ，６０ｉ部分を除いてパッケージ６０の全体を電磁シールドする構造であるから、不要な高周波信号がパッケージ内部へ混入したり、パッケージ内から不要な高周波信号がパッケージ外へ放射されるのを効果的に防止できる。

【００３５】図１０はこの発明に係るＭＭＩＣパッケージ組立の第４の実施例を示す模式縦断面図である。このＭＭＩＣパッケージ組立９０は、パッケージ３のベース４１を構成する上側の誘電体板（セラミック板）４１ａのパッケージ内面側に給電用のマイクロストリップライン９１を形成し、このマイクロストリップライン９１とＭＭＩＣ９２の出力もしくは入力端子９３との間をボンディングワイヤ９４で電気的に接続するようにしたものである。

【００３６】図１に示したようにＭＭＩＣ２の表面に給電用のマイクロストリップライン２ｆを設ける構造の場合は、ＭＭＩＣ２の取り付けに際し高い位置精度が要求されるが、図１０に示す構造ではＭＭＩＣ９２の取り付け精度が緩和される。

【００３７】図１１はこの発明に係るＭＭＩＣパッケージ組立の第５の実施例を示すパッケージの裏面側の斜視図である。このＭＭＩＣパッケージ組立９５は、パッケージ３の裏面（外面）にアンテナ（放射導体）に替えてスロット結合を利用した給電用のマイクロストリップライン（高周波信号伝送ライン）９６を形成し、このマイクロストリップライン９６を介してＭＭＩＣからの高周波信号を他の回路へ供給したり、他の回路からの高周波信号（例えば局部発振信号等）をパッケージ３内のＭＭＩＣへ供給するようにしたものである。

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【００３８】

【発明の効果】以上説明したようにこの発明に係るＭＭＩＣパッケージ組立は、パッケージの外面に形成された平面アンテナまたは高周波信号伝送ラインとパッケージ内に設けた入力ラインまたは出力ラインとを接地導体のスロット部を介してスロット結合する構造としたので、電磁結合によって例えばＭＭＩＣの高周波出力信号を平面アンテナへ給電し電波を放射させたり、平面アンテナで受信した高周波信号を電磁結合によってパッケージ内部のＭＭＩＣへ供給することができる。また、平面アンテナの代りに高周波伝送ラインを形成することで、パッケージ内の出力信号を外部へ供給したり、外部からの高周波信号をパッケージ内のＭＭＩＣへ供給することができる。

【００３９】さらに、電磁結合を行なうスロット部以外は接地導体とすることができるので、不要な高周波信号がパッケージ内部へ混入したり、パッケージ内から不要な高周波信号がパッケージ外へ放射されるのを効果的に防止できる。

【図面の簡単な説明】

【図１】この発明に係るＭＭＩＣパッケージ組立の縦断面図

【図２】パッケージの蓋体を外した状態の斜視図

【図３】端子ブロックの斜視図

【図４】パッケージを裏面側から見た斜視図

【図５】ＭＭＩＣの断面構造図

【図６】マイクロストリップラインとスロット部と平面アンテナの位置関係を示す模式平面説明図

【図７】この発明に係るＭＭＩＣパッケージ組立の第２の実施例を示す模式縦断面図

【図８】この発明に係るＭＭＩＣパッケージ組立の第３の実施例を示す模式縦断面図

【図９】この発明に係るＭＭＩＣパッケージ組立を利用して構成した車載用レーダモジュールのブロック構成図

【図１０】この発明に係るＭＭＩＣパッケージ組立の第４の実施例を示す模式縦断面図

【図１１】この発明に係るＭＭＩＣパッケージ組立の第５の実施例を示すパッケージの裏面側の斜視図

【図１２】従来のスロット結合マイクロストリップアンテナの模式構造図

【図１３】他の従来のマイクロ波集積回路の断面図

【符号の説明】

１，１０，２０，９０，９５　ＭＭＩＣパッケージ組立

２，７０，９２　ＭＭＩＣ（モノリシックマイクロ波集積回路）

２ｆ，６４，９１　マイクロストリップライン

３，３０，６０　パッケージ

４，３１　基体

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５，３２　蓋体
４１，４１Ｓ　ベース
４１ａ，４１ｂ，６０ｄ，６０ｅ　上下の誘電体板（セラミック板）
４１ｃ，６０ｃ　接地導体
４１ｄ，６０ｂ　スロット部

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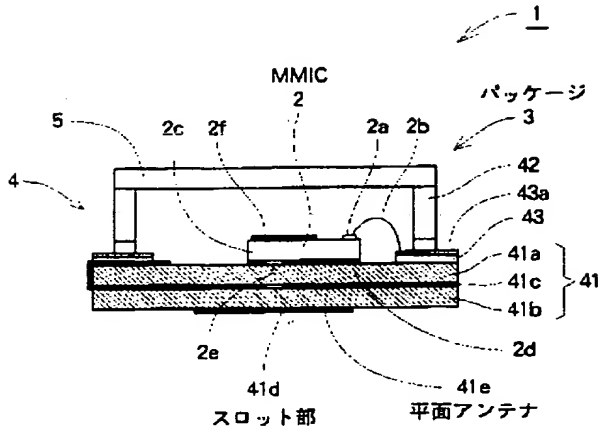
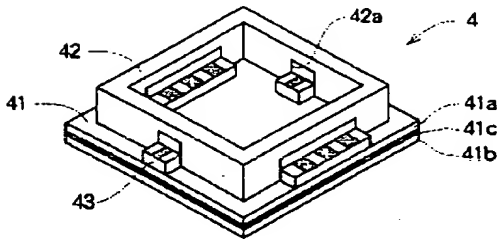
４１ｅ，６３　平面アンテナ（放射導体）
４２　フレーム
４３，６０ｆ，６０ｇ，６０ｈ，６０ｉ　端子ブロック
９６　給電用マイクロストリップライン（高周波信号伝送ライン）

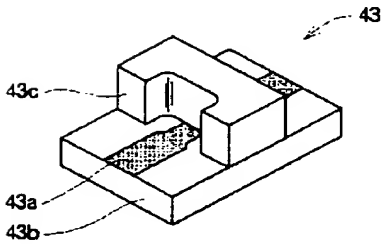
【図１】



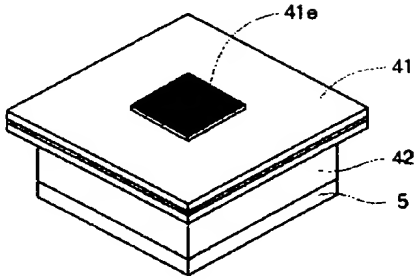
【図２】



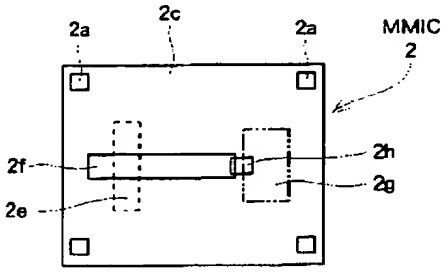
【図３】



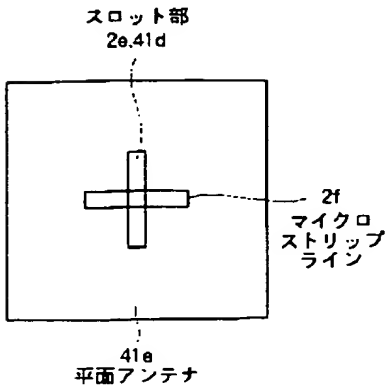
【図４】



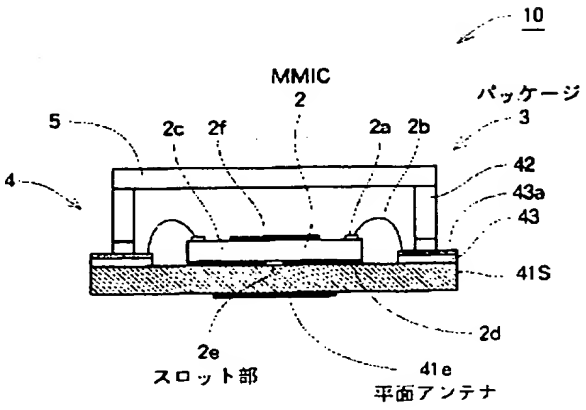
【図５】



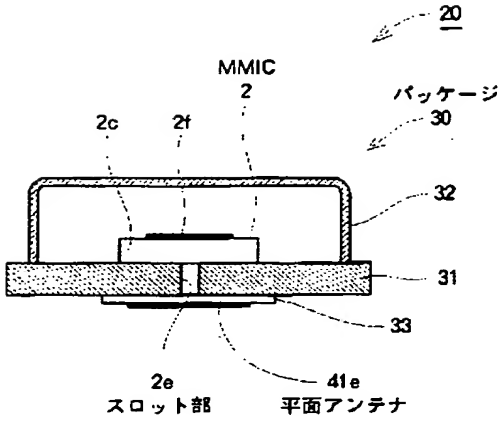
【図６】



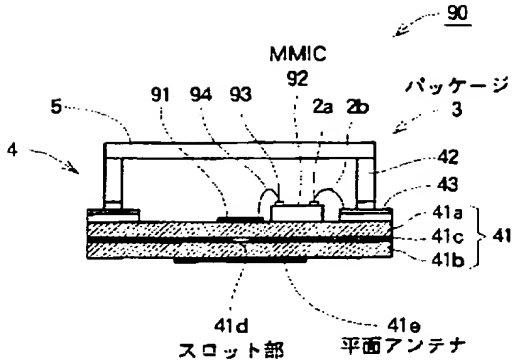
【図７】



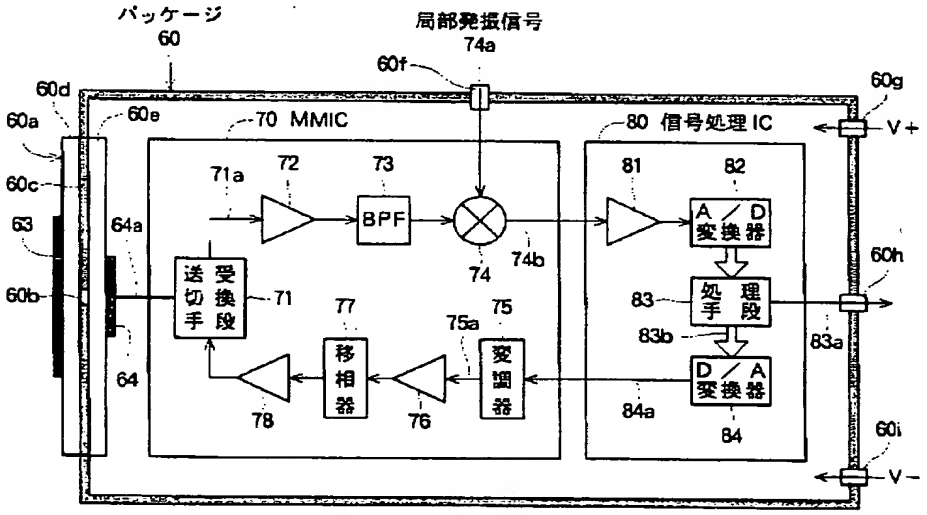
【図8】



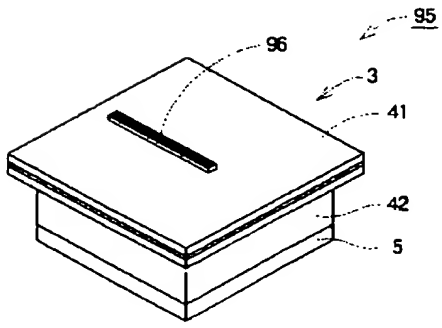
【図10】



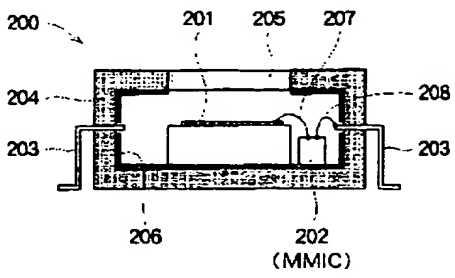
【図9】



【図11】

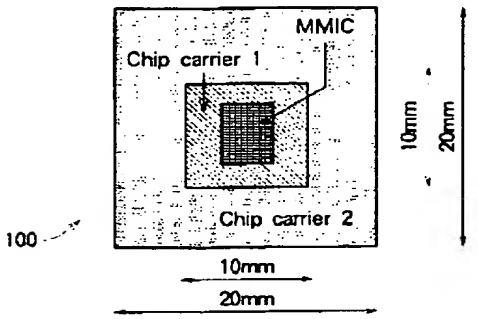


【図13】

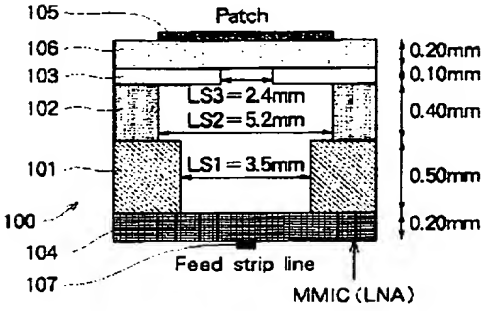


【図12】

(a)　裏面から見たMMICとチップキャリア



(b)　スロット断面と基板の寸法



XP-002143806

AN - 1996-491350 [50]
AP - JP19950056132 19950315
CPY - HOND
DC - U11 U14 W02 W06
FS - EPI
IC - G01S7/03 ; H01L23/04 ; H01P5/08 ; H01Q13/08
MC - U11-D01A4 U14-H03C2 W02-A02 W02-A08B W02-B02A W06-A04G9
PA - (HOND) HONDA MOTOR CO LTD
PN - JP8250913 A 19960927 DW199649 H01P5/08 008pp
PR - JP19950056132 19950315
XIC - G01S-007/03 ; H01L-023/04 ; H01P-005/08 ; H01Q-013/08
XP - N1996-414244
AB - J08250913 The assembly has a ground conductor (41c) with a slot (41d) placed between two dielectric board (41a,41b) on which a monolithic-microwave integrated circuit (2) is placed on the surface of top dielectric board. An airtight module encloses the MMIC which has a microstrip line on top of it. The microstrip line arranges the slot in longitudinal direction to perpendicularly intersect the longitudinal direction of the microstrip line.
- A flat antenna (41e) with high-frequency signal transmission line is formed at the bottom external surface of the lower dielectric board. The flat antenna is electro-magnetically attached to the microstrip line through the slot, and transmits high-frequency signal.
- ADVANTAGE - Prevents unnecessary high-frequency signal from mixing inside package and from being emitted from package since ground conductor and slot are electro-magnetically coupled.
- (Dwg.1/13)
IW - MONOLITHIC MICROWAVE INTEGRATE CIRCUIT PACKAGE ASSEMBLE FLAT ANTENNA ELECTRO MAGNETIC ATTACH MICROSTRIP LINE THROUGH SLOT TRANSMIT HIGH FREQUENCY SIGNAL
IKW - MONOLITHIC MICROWAVE INTEGRATE CIRCUIT PACKAGE ASSEMBLE FLAT ANTENNA ELECTRO MAGNETIC ATTACH MICROSTRIP LINE THROUGH SLOT TRANSMIT HIGH FREQUENCY SIGNAL
NC - 001
OPD - 1995-03-15
ORD - 1996-09-27
PAW - (HOND) HONDA MOTOR CO LTD
TI - Monolithic-microwave-integrated-circuit package assembly - has flat antenna that is electro-magnetically attached to microstrip line through slot, and transmits high-frequency signal

APS 418 Packaged Integrated Circuit:

f opt eynde . 02 .7.8 ig.38.

JP 8250913 JP 237867 US 5528222

	FEATURE	D1	D2	D3		
1	-Packaged Integrated Circuit PIC -comprising at least one radio component. Integrated in IC die -associated with radio antenna. - IC die being included in PIC. - radio frequency antenna - included in PIC - excluded from IC die	× 1 × MMIC		× 260,270 × C3, 111 × × × × C4, 11 (220) × ×	C4 Fig 2	
2(1)	- PIC includes IC package - which houses radio frequency component and radio antenna - antenna constituted metal object part of IC package.					
3(2)	radio antenna constituted by wire bonding coupled to IC die					
4(2)	radio antenna applied on metal lead frame IC package					
5(1)	- radio antenna consist of at least one planar metal pattern separated from ground by insulating layer					
6(5)						

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CLAIMS

[Claim(s)]
[Claim 1] the grounding which it had in the slot section to the aforementioned package while the flat antenna or the RF signal-transmission line was formed to the superficies of the package which carries out sealing hold of the MMIC -- the flat antenna or the RF signal-transmission line which formed a conductor and formed in the superficies of the input prepared in the aforementioned package, or the output line and the aforementioned package -- the aforementioned slot section -- minding -- electromagnetism -- the MMIC package assembly characterized by to make it join together-like and to transmit a RF signal

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[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] the flat antenna or RF transmission line which this invention required for MMIC package assembly which carried out sealing closure of the MMIC (monolithic microwave integrated circuit), especially was formed in the superficies of a package, and the RF signal line inside a package -- slot coupling -- using -- electromagnetism -- it is joining together-like, and while mixing and radiation of an unnecessary RF signal are prevented, it is related with MMIC package assembly made into highly reliable closure structure
[0002]
[Description of the Prior Art] Corporation Electronic-intelligence communication society The following techniques are indicated by the paper of "the slot coupling micro-stripe antenna which used Ka band MMIC for the electric supply substrate" of **** technical report A and P94-14(1994-05) P37-P43. A slot coupling micro-stripe antenna is one of the promising elements of an active array antenna. When using on high frequencies, such as Ka band and a millimeter wave band, it is important to suppress an electric supply loss small. For this reason, the structure which uses the active circuit, such as MMIC, itself as an electric supply substrate is effective. however, a grounding -- a conductor -- when the conductor of a plate is using the thin thing of micron units, such as gold (Au) by which vacuum evaporationo was carried out, for copper foil or the rear face of MMIC, the mechanical strength and the exhaust heat effect are inadequate
[0003] in order to solve the technical probrem of a mechanical strength and the exhaust heat effect -- a grounding -- the slot coupling micro-stripe antenna with which the desired antenna property was acquired even if it thickened the conductor is proposed by JP,6-97724,A moreover, the RF signal which passes through the inside of a slot in JP,6-97724,A and other micro stripes -- in order to lose the combination with a conductor -- the internal surface of parietal bone of a penetration slot -- a grounding -- the technique which forms a conductor is proposed
[0004] Drawing 12 is ** type structural drawing of the conventional slot coupling micro-stripe antenna indicated in the drawing 7 of the above-mentioned paper. Drawing 12 (a) shows MMIC arrangement of a trial production antenna, and drawing 12 (b) shows a slot cross section. this slot coupling micro-stripe antenna 100 -- a grounding -- a conductor -- a plate is divided into three layers and it has the structure which divided slot length into three steps the 1st and 2nd groundings -- a conductor -- a plate 101,102 -- the chip-carrier fraction of MMIC104 -- accomplishing -- the 3rd grounding -- a conductor -- the plate 103 has the structure of the object for impedance matching By making it such structure, with the chip simple substance, handling can deal with difficult MMIC simple only with a drawer wiring of a power track, and is presupposing that adjustment of slot length is also become easy. In addition, the rectangular patch radiator (patch antenna) 105 is formed on the radiation substrate 106. A sign 107 is a microstrip line for electric supply.
[0005] However, for the reason for trial production evaluation, the slot coupling micro-stripe antenna 100 shown in drawing 12 needs to seal MMIC in packages, such as a ceramic, to put in practical use by MMIC104 being nakedness.
[0006] In JP,1-310572,A, the microwave integrated circuit which sealed an antenna element and MMIC in the same container is proposed. Drawing 13 is a cross section of the microwave integrated circuit indicated in 1 view of JP,1-310572,A. this conventional microwave integrated circuit 200 consists of an antenna element 201, an amplifying circuit 202 which consists of a MMIC chip, two or more terminals 203, and an airtight container (it is described as a case below) 204 -- having -- **** -- the inside of a case 204 -- near the radiation opening 205 and the terminal 203 -- removing -- all -- ultraviolet-rays protection and electromagnetism -- the metal membrane or the metal 206 by metallizing etc. is given for the shield Radiation opening 205 is carried out an amplification and frequency conversion by the amplifying circuit 202 which it constitutes from the matter which passes the Hertzian wave like glass or a ceramics, and holds airtightness, and the signal which passed this radiation opening 205 from the exterior is received by the antenna element 201, passes to bonding wire 207, and consists of a MMIC chip, and is outputted from a terminal 203 through bonding wire 208.
[0007]
[Problem(s) to be Solved by the Invention] As mentioned above, for the reason for trial production evaluation, the slot coupling micro-stripe antenna 100 shown in drawing 12 needs to seal MMIC in packages, such as a ceramic, to put in practical use by MMIC104 being nakedness. As shown in drawing 13 </A>, when sealing a case 204 for an antenna element 201 and MMIC202, you have to form the radiation opening 205 for passing a Hertzian wave. However, if the radiation opening 205 is formed, an unnecessary RF signal may mix in a package (case) from this radiation opening 205, or an unnecessary RF signal may be emitted to the exterior out of a package.
[0008] while it was made in order that this invention might solve such a technical probrem, and the hermetic seal of the MMIC is carried out into a package -- the superficies of the package -- the transmission line of an antenna element or a RF signal -- forming -- slot coupling -- using -- the inside of a package, an antenna element, and a transmission line -- electromagnetism -- it is making it join together-like, and aims at offering MMIC package assembly of the high-reliability structure which prevented mixing in a package of an unnecessary RF signal, and the radiation to the package exterior
[0009]
[Means for Solving the Problem] MMIC package assembly which starts this invention in order to solve the aforementioned technical probrem While a flat antenna or a RF signal-transmission line is formed in the superficies of the package which

carries out sealing hold of the MMIC A conductor is formed. the grounding which equipped this package with the slot section -- the flat antenna or RF signal-transmission line formed in the input or output line prepared in the package, and the superficies of a package -- the slot section -- minding -- electromagnetism -- it is characterized by making it join together-like and transmitting a RF signal

[0010]

[Function] the input line or output line prepared in the flat antenna or RF signal-transmission line formed in the superficies of a package, and the package -- a grounding -- since it considered as the structure which carries out slot coupling through the slot section of a conductor, the RF signal which was made to emit a Hertzian wave or received the RF output signal of MMIC by the flat antenna by supplying electric power to a flat antenna by the electromagnetic coupling can be supplied to MMIC inside a package by the electromagnetic coupling Moreover, by forming a RF transmission line instead of a flat antenna, the output signal in a package can be supplied to the exterior, or the RF signal from the exterior can be supplied to MMIC in a package.

[0011] except for the slot section which performs an electromagnetic coupling -- a grounding -- since it can consider as a conductor, an unnecessary RF signal can mix inside a package, or it can prevent effectively that an unnecessary RF signal is emitted out of a package out of a package

[0012]

[Example] The example of this invention is explained below based on an accompanying drawying. It is ** type flat-surface explanatory drawing [plan / ** type / of MMIC] in which showing the perspective diagram and the drawing 5 as which the perspective diagram of the status that ** type drawing of longitudinal section of MMIC package assembly which drawing 1 requires for this invention, and the drawing 2 removed the lid of a package, and the drawing 3 looked at the perspective diagram of terminal block, and drawing 4 looked at the package from the rear-face side, and showing / 6 / the physical relationship of a microstrip line, the slot section, and a flat antenna.

[0013] MMIC package assembly 1 which starts this invention as shown in drawing 1 comes to carry out sealing hold of MMIC (monolithic microwave integrated circuit)2 into a package 3. A package 3 comes to carry out hermetic sealing of the lid 5 to a base 4.

[0014] As shown in drawing 2 , a base 4 forms the base 41, the frame 42, and two or more terminal block 43 in one, and becomes. the grounding by which the base 41 was ****ed between the up-and-down dielectric plates (for example, ceramic plate) 41a and 41b and them as shown in drawing 1 -- a conductor -- it consists of three layers with 41c a grounding -- a conductor -- 41c is equipped with 41d of the rectangle-like slot sections a grounding -- a conductor -- 41c -- a conductor -- a plate may be processed and formed, and vacuum evaporationo etc. may carry out and form a conductive material in the dielectric plates 41a and 41b of a top or the bottom

[0015] As shown in drawing 4 , flat antenna (radiation conductor) 41e of the shape for example, of a rectangle is provided in the inferior-surface-of-tongue side (superficies side of a package) of lower dielectric plate 41b. Flat antenna (radiation conductor) 41e may stick and form a metal plate or a metallic foil, and may carry out and form vacuum evaporationo etc. for a conductive material.

[0016] Using conductive materials, such as a metal, it forms in the shape of a frame, and a frame 42 becomes, as shown in drawing 2 . A frame 42 is equipped with notch 42a for forming terminal block 43. As shown in drawing 3 , terminal block 43 consists of the terminal assembly 43b equipped with conductive lead section 43a made from a ceramic, and the insulating block 43c made from a ceramic. As shown in drawing 2 , the terminal block 43 equipped with two or more lead section 43a and terminal-block 43a equipped with single lead section 43a are arranged right-angled, and the RF signal is considering as the structure which is hard to mix to a power system by carrying out terminal block 43 equipped with the object for current supply, and single lead section 43a for the terminal block 43 equipped with two or more lead section 43a to I/O of a RF signal.

[0017] it is shown in drawing 1 -- as -- a grounding -- a conductor -- the grounding which installed 41c from the side face of upper dielectric plate 41b to the top, and installed it -- a conductor -- it is good also as structure of connecting 41c and the metal frame 42 electrically in addition, the specific side in drawing 1 -- receiving -- a grounding -- a conductor -- although the example which installs 41c was shown -- all four sides -- a grounding -- you may be made to install a conductor

[0018] The lid 5 is formed with the ceramic plate or the conductive material. A lid 5 is good also as structure which carries out the vacuum evaporationo of the conductive metal to the inferior surface of tongue (internal-surface-of-parietal-bone side of a package) of a ceramic plate. the fraction of the terminal block 43 for I/O at considering as the structure which a metal frame and the metal lid 5 connect electrically, where it made the lid 5 into conductive structure and the hermetic seal of the lid 5 is carried out to a frame 42 -- removing -- the 6th page of a package 3 -- electromagnetism -- it can consider as shield structure By considering as such structure, it can prevent effectively that an unnecessary RF signal is emitted from mixing and the interior of a package of an unnecessary signal.

[0019] As shown in drawing 1 , it has connected electrically by bonding wire 2b between fetch electrode 2a of MMIC2 and lead section 43a of terminal block 43 which fixed in the package 3. MMIC2 forms various kinds of circuit elements in substrate 2c of half-insulation, such as GaAs. 2d of grounding metals is formed in the rear face of substrate 2c. 2d of this grounding metal is equipped with slot section 2e of the shape for example, of a rectangle which does not prepare a metal. Microstrip-line (micro stripe conductor) 2f is prepared in the top side of MMIC2.

[0020] the first rank of 2h of the RF output transistor 2g [for sending] output terminals by which the microstrip-line (micro stripe conductor) 2f end side was formed in the front-face side of substrate 2c as shown in drawing 5 , or a receiving circuit -- it has connected with a circuit etc. The longitudinal direction of slot section 2e formed in the rear-face side of substrate 2c and the microstrip-line 2f longitudinal direction are taken as the arrangement which intersects perpendicularly.

[0021] the grounding sandwiched by the vertical two-layer dielectric plates 41a and 41b which microstrip-line 2c was made to be located in the abbreviation mid gear of flat antenna 41e formed in the superficies of a package 3, and were shown in drawing 1 as shown in drawing 6 -- a conductor -- rectangle-like slot section 41c is formed in 41c so that it may intersect perpendicularly with the longitudinal direction the longitudinal direction of whose is microstrip-line 2f

[0022] Therefore, between microstrip-line 2f formed in the front-face side of substrate 2c, and flat antenna 41e formed in the rear face of a package 3, 41d of the 2nd slot section formed in 1st slot section 2e formed in the rear face of substrate 2c and

the base 41 of a package 3 is arranged by the position relation.
[0023] In such structure, when electric power is supplied to microstrip-line 2f for example, in a RF sending signal, from microstrip-line 2f, flat antenna 41e is excited through two steps of slot sections 2e and 41d, and the electromagnetic wave corresponding to a RF sending signal is emitted in the perpendicular orientation to the front face of flat antenna 41e. except except two steps of slot section 2e which carries out the electromagnetic coupling of flat antenna 41e and the interior of a package 3 which were established in the superficies of a package 3, and 41d for terminal-block 43 -- the whole surface of a package 3 -- continuing -- a grounding -- since it can consider as a conductor, an unnecessary RF signal can mix inside a package, or it can prevent effectively that an unnecessary RF signal is emitted out of a package out of a package
[0024] Drawing 7 is ** type drawing of longitudinal section showing other examples of MMIC package assembly concerning this invention. flat antenna 41e formed in the base of microstrip-line 2f which MMIC package assembly 10 shown in drawing 7 formed slot section 2e which does not prepare 2d of grounding metals in the rear-face side of substrate 2c of MMIC2, and was formed in the front-face side of substrate 2c through this slot section 2e, and the package 3 -- electromagnetism -- it is made to make it join together-like the grounding shown in base 41S of a package 3 in this one step slot configuration in drawing 1 -- a conductor -- it is not necessary to form 41c and 41d of the slot sections For this reason, package assembly 10 can be made cheap that what is necessary is just to form flat antenna 41e in base 41S with the standard product made from a ceramics by vacuum evaporationo etc., for example. Moreover, by forming slot section 2e in the abbreviation center section of substrate 2c, the homogeneity of the size of the grounding field of the circumference of slot section 2e is carried out mostly, and stabilization of an electromagnetic-coupling property is attained.
[0025] Drawing 8 is ** type drawing of longitudinal section showing the 3rd example of MMIC package assembly concerning this invention. MMIC package assembly 20 shown in drawing 8 carries out sealing hold of MMIC2 into the metal package 30. A package 30 comes to carry out hermetic sealing of the metal lid 32 to the metal base 31. Slot section 31a which consists of plane view rectangle-like **** is formed in a base 31, and it is made to maintain the airtight in a package 30 by closing this slot section 31a with dielectric **** 33 made from a ceramic at it. and the base of dielectric **** 33 -- flat antenna 41e -- forming -- a flat antenna 41 -- microstrip-line 2f formed in the front-face side of e and MMIC2 -- slot section 31a -- minding -- electromagnetism -- it is made to join together-like Since the whole package 30 is metal, it can prevent effectively that an unnecessary RF signal is emitted from mixing and the interior of a package of an unnecessary signal.
[0026] Drawing 9 is a block block diagram of the radar module for mount constituted using MMIC package assembly concerning this invention. the grounding which base or top (you may be the side face) 60a of a package 60 equipped with slot section 60b -- a conductor -- the ceramic to which 60c was ****ed with the two-layer ceramic plates 60d and 60e, and other fields of a package 60 carried out the metal or the conductor layer for vacuum evaporationo etc. except for the fraction of each terminal block 60f, 60g, 60h, and 60i -- forming -- the whole of a package 60 -- electromagnetism -- it is considering as the structure
[0027] Inside the package 60, seal hold of MMIC70 which processes the RF signal of a several 10GHz band and which consists of a GaAs chip, for example, and analog to digital signal-processing IC80 which processes the signal of a frequency lower than a ********** band and which consists of an Si chip, for example is carried out. It is made to receive supply of power V+ of positive/negative, and V- through 60g of terminal block, and terminal-block 60i.
[0028] A flat antenna 63 is formed in the base [of a package 60], or superficies side of top (you may be the side face) 60a, and the microstrip line (micro stripe conductor) 64 is formed in a internal-surface-of-parietal-bone side.
[0029] Between a microstrip line 64 and the transmission-and-reception changeover means 71, it has connected by bonding wire 64a. It is good also as structure of forming a microstrip line 64 in a rear face at MMIC70, and connecting a microstrip line 64 and the transmission-and-reception changeover means 71 through the Bahia hall etc.
[0030] The transmission-and-reception changeover means 71 is constituted using a circulator circuit or a switching circuit. Input-signal 71a is amplified by the low noise amplifier 72, the signal component of a desired frequency band is extracted through a band-pass filter (BPF) 73, and intermediate-frequency-signal 74b which mixed with local oscillation signal 74a supplied from the exterior through 60f (external end-connection child) of terminal block with a mixer (mixer) 74, carried out frequency conversion, and was obtained is supplied to the intermediate frequency amplifying circuit 81 in analog to digital signal-processing IC80 (IF amplifying circuit).
[0031] In addition, slit combination is prepared in the 1 side face of a package 60, without preparing 60f (external end-connection child) of terminal block, and it may be made to supply local oscillation signal 74a in a package 60 by the electromagnetic coupling.
[0032] After amplifying intermediate-frequency-signal 74b by the intermediate frequency amplifying circuit 81, an input signal is analyzed by performing digital signal processing with the processing means 83 which changed into the digital intermediate frequency signal and was constituted from an A/D converter using the microprocessor, and it is made to output the distance information to a target etc. to the exterior as serial-data 83a.
[0033] Modulation command 83b outputted from the processing means 83 is changed into analog signal (for example, voltage signal) 84a which corresponds by D/A converter 84, the modulator 75 in MMIC70 is supplied, modulating-signal 75a is amplified by the high-frequency amplifier 76, after carrying out phase adjustment with the phase vessel 77, power amplification is carried out by the RF power amplifier 78, the microstrip line 64 for electric supply is excited through the transmission-and-reception changeover means 71, and it is made to emit a radar Hertzian wave from the flat antenna 63 through slot coupling.
[0034] Thus, the radar module for mount constituted using MMIC package assembly concerning invention is made to perform a reception of the rf radiation from a flat antenna 63, and a reflected wave using slot coupling. slot section 60b and each terminal block 60f, 60g, and 60h, and 60i fraction -- removing -- the whole of a package 60 -- electromagnetism -- since it is the structure to shield, an unnecessary RF signal can mix inside a package, or it can prevent effectively that an unnecessary RF signal is emitted out of a package out of a package
[0035] Drawing 10 is ** type drawing of longitudinal section showing the 4th example of MMIC package assembly concerning this invention. This MMIC package assembly 90 forms the microstrip line 91 for electric supply, and connects electrically between the output of this microstrip line 91 and MMIC92, or the input terminals 93 to the package internal-surface-of-parietal-bone side of dielectric plate (ceramic plate) 41a of the top which constitutes the base 41 of a

package 3 by the bonding wire 94.
[0036] Although a high position precision is demanded in case of installation of MMIC2 in the case of the structure of preparing microstrip-line 2f for electric supply in the front face of MMIC2 as shown in drawing 1 , the installation precision of MMIC92 is eased with the structure shown in drawing 10 .
[0037] Drawing 11 is a perspective diagram by the side of the rear face of the package which shows the 5th example of MMIC package assembly concerning this invention. This MMIC package assembly 95 forms the microstrip line 96 for electric supply (RF signal-transmission line) which changed to the antenna (radiation conductor) and used slot coupling, and through this microstrip line 96, the RF signal from MMIC is supplied to other circuits, or it supplies the RF signals (for example, local oscillation signal etc.) from other circuits to the rear face (superficies) of a package 3 to MMIC in a package 3.
[0038]
[Effect of the Invention] the input line or the output line which established MMIC package assembly which starts this invention as explained above in the flat antenna or the RF signal-transmission line formed in the superficies of a package, and the package -- a grounding -- since it considered as the structure which carries out slot coupling through the slot section of a conductor, the RF signal which made emit a Hertzian wave or received the RF output signal of MMIC by the flat antenna by supplying electric power to a flat antenna by the electromagnetic coupling can supply to MMIC inside a package by the electromagnetic coupling Moreover, by forming a RF transmission line instead of a flat antenna, the output signal in a package can be supplied to the exterior, or the RF signal from the exterior can be supplied to MMIC in a package.
[0039] furthermore, except for the slot section which performs an electromagnetic coupling -- a grounding -- since it can consider as a conductor, an unnecessary RF signal can mix inside a package, or it can prevent effectively that an unnecessary RF signal is emitted out of a package out of a package

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Field

[Field of the Invention] the flat antenna or RF transmission line which this invention required for MMIC package assembly which carried out sealing closure of the MMIC (monolithic microwave integrated circuit), especially was formed in the superficies of a package, and the RF signal line inside a package -- slot coupling -- using -- electromagnetism -- it is joining together-like, and while mixing and radiation of an unnecessary RF signal are prevented, it is related with MMIC package assembly made into highly reliable closure structure

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Technique

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[0003] in order to solve the technical probrem of a mechanical strength and the exhaust heat effect -- a grounding -- the slot coupling micro-stripe antenna with which the desired antenna property was acquired even if it thickened the conductor is proposed by JP,6-97724,A moreover, the RF signal which passes through the inside of a slot in JP,6-97724,A and other micro stripes -- in order to lose the combination with a conductor -- the internal surface of parietal bone of a penetration slot -- a grounding -- the technique which forms a conductor is proposed

[0004] Drawing 12 is ** type structural drawing of the conventional slot coupling micro-stripe antenna indicated in the drawing 7 of the above-mentioned paper. Drawing 12 (a) shows MMIC arrangement of a trial production antenna, and drawing 12 (b) shows a slot cross section. this slot coupling micro-stripe antenna 100 -- a grounding -- a conductor -- a plate is divided into three layers and it has the structure which divided slot length into three steps the 1st and 2nd groundings -- a conductor -- a plate 101,102 -- the chip-carrier fraction of MMIC104 -- accomplishing -- the 3rd grounding -- a conductor -- the plate 103 has the structure of the object for impedance matching By making it such structure, with the chip simple substance, handling can deal with difficult MMIC simple only with a drawer wiring of a power track, and is presupposing that adjustment of slot length is also become easy. In addition, the rectangular patch radiator (patch antenna) 105 is formed on the radiation substrate 106. A sign 107 is a microstrip line for electric supply.

[0005] However, for the reason for trial production evaluation, the slot coupling micro-stripe antenna 100 shown in drawing 12 needs to seal MMIC in packages, such as a ceramic, to put in practical use by MMIC104 being nakedness.

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Effect

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As mentioned above, for the reason for trial production evaluation, the slot coupling micro-stripe antenna 100 shown in drawing 12 needs to seal MMIC in packages, such as a ceramic, to put in practical use by MMIC104 being nakedness. As shown in drawing 13 , when sealing a case 204 for an antenna element 201 and MMIC202, you have to form the radiation opening 205 for passing a Hertzian wave. However, if the radiation opening 205 is formed, an unnecessary RF signal may mix in a package (case) from this radiation opening 205, or an unnecessary RF signal may be emitted to the exterior out of a package.
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MEANS

[Means for Solving the Problem] MMIC package assembly which starts this invention in order to solve the aforementioned technical probrem While a flat antenna or a RF signal-transmission line is formed in the superficies of the package which carries out sealing hold of the MMIC A conductor is formed. the grounding which equipped this package with the slot section -- the flat antenna or RF signal-transmission line formed in the input or output line prepared in the package, and the superficies of a package -- the slot section -- minding -- electromagnetism -- it is characterized by making it join together-like and transmitting a RF signal

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OPERATION

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[0013] MMIC package assembly 1 which starts this invention as shown in drawing 1 comes to carry out sealing hold of MMIC (monolithic microwave integrated circuit)2 into a package 3. A package 3 comes to carry out hermetic sealing of the lid 5 to a base 4.

[0014] As shown in drawing 2 , a base 4 forms the base 41, the frame 42, and two or more terminal block 43 in one, and becomes. the grounding by which the base 41 was ****ed between the up-and-down dielectric plates (for example, ceramic plate) 41a and 41b and them as shown in drawing 1 -- a conductor -- it consists of three layers with 41c a grounding -- a conductor -- 41c is equipped with 41d of the rectangle-like slot sections a grounding -- a conductor -- 41c -- a conductor -- a plate may be processed and formed, and vacuum evaporationo etc. may carry out and form a conductive material in the dielectric plates 41a and 41b of a top or the bottom

[0015] As shown in drawing 4 , flat antenna (radiation conductor) 41e of the shape for example, of a rectangle is provided in the inferior-surface-of-tongue side (superficies side of a package) of lower dielectric plate 41b. Flat antenna (radiation conductor) 41e may stick and form a metal plate or a metallic foil, and may carry out and form vacuum evaporationo etc. for a conductive material.

[0016] Using conductive materials, such as a metal, it forms in the shape of a frame, and a frame 42 becomes, as shown in drawing 2 . A frame 42 is equipped with notch 42a for forming terminal block 43. As shown in drawing 3 , terminal block 43 consists of the terminal assembly 43b equipped with conductive lead section 43a made from a ceramic, and the insulating block 43c made from a ceramic. As shown in drawing 2 , the terminal block 43 equipped with two or more lead section 43a and terminal-block 43a equipped with single lead section 43a are arranged right-angled, and the RF signal is considering as the structure which is hard to mix to a power system by carrying out terminal block 43 equipped with the object for current supply, and single lead section 43a for the terminal block 43 equipped with two or more lead section 43a to I/O of a RF signal.

[0017] it is shown in drawing 1 -- as -- a grounding -- a conductor -- the grounding which installed 41c from the side face of upper dielectric plate 41b to the top, and installed it -- a conductor -- it is good also as structure of connecting 41c and the metal frame 42 electrically in addition, the specific side in drawing 1 -- receiving -- a grounding -- a conductor -- although the example which installs 41c was shown -- all four sides -- a grounding -- you may be made to install a conductor

[0018] The lid 5 is formed with the ceramic plate or the conductive material. A lid 5 is good also as structure which carries out the vacuum evaporationo of the conductive metal to the inferior surface of tongue (internal-surface-of-parietal-bone side of a package) of a ceramic plate. the fraction of the terminal block 43 for I/O at considering as the structure which a metal frame and the metal lid 5 connect electrically, where it made the lid 5 into conductive structure and the hermetic seal of the lid 5 is carried out to a frame 42 -- removing -- the 6th page of a package 3 -- electromagnetism -- it can consider as shield structure By considering as such structure, it can prevent effectively that an unnecessary RF signal is emitted from mixing and the interior of a package of an unnecessary signal.

[0019] As shown in drawing 1 , it has connected electrically by bonding wire 2b between fetch electrode 2a of MMIC2 and lead section 43a of terminal block 43 which fixed in the package 3. MMIC2 forms various kinds of circuit elements in substrate 2c of half-insulation, such as GaAs. 2d of grounding metals is formed in the rear face of substrate 2c. 2d of this grounding metal is equipped with slot section 2e of the shape for example, of a rectangle which does not prepare a metal. Microstrip-line (micro stripe conductor) 2f is prepared in the top side of MMIC2.

[0020] the first rank of 2h of the RF output transistor 2g [for sending] output terminals by which the microstrip-line (micro stripe conductor) 2f end side was formed in the front-face side of substrate 2c as shown in drawing 5 , or a receiving circuit -- it has connected with a circuit etc. The longitudinal direction of slot section 2e formed in the rear-face side of substrate 2c and the microstrip-line 2f longitudinal direction are taken as the arrangement which intersects perpendicularly.

[0021] the grounding sandwiched by the vertical two-layer dielectric plates 41a and 41b which microstrip-line 2c was made to be located in the abbreviation mid gear of flat antenna 41e formed in the superficies of a package 3, and were shown in drawing 1 as shown in drawing 6 -- a conductor -- rectangle-like slot section 41c is formed in 41c so that it may intersect perpendicularly with the longitudinal direction the longitudinal direction of whose is microstrip-line 2f

[0022] Therefore, between microstrip-line 2f formed in the front-face side of substrate 2c, and flat antenna 41e formed in the rear face of a package 3, 41d of the 2nd slot section formed in 1st slot section 2e formed in the rear face of substrate 2c and the base 41 of a package 3 is arranged by the position relation.

[0023] In such structure, when electric power is supplied to microstrip-line 2f for example, in a RF sending signal, from microstrip-line 2f, flat antenna 41e is excited through two steps of slot sections 2e and 41d, and the electromagnetic wave corresponding to a RF sending signal is emitted in the perpendicular orientation to the front face of flat antenna 41e. except

except two steps of slot section 2e which carries out the electromagnetic coupling of flat antenna 41e and the interior of a package 3 which were established in the superficies of a package 3, and 41d for terminal-block 43 -- the whole surface of a package 3 -- continuing -- a grounding -- since it can consider as a conductor, an unnecessary RF signal can mix inside a package, or it can prevent effectively that an unnecessary RF signal is emitted out of a package out of a package

[0024] Drawing 7 is ** type drawing of longitudinal section showing other examples of MMIC package assembly concerning this invention. flat antenna 41e formed in the base of microstrip-line 2f which MMIC package assembly 10 shown in drawing 7 formed slot section 2e which does not prepare 2d of grounding metals in the rear-face side of substrate 2c of MMIC2, and was formed in the front-face side of substrate 2c through this slot section 2e, and the package 3 -- electromagnetism -- it is made to make it join together-like the grounding shown in base 41S of a package 3 in this one step slot configuration in drawing 1 -- a conductor -- it is not necessary to form 41c and 41d of the slot sections For this reason, package assembly 10 can be made cheap that what is necessary is just to form flat antenna 41e in base 41S with the standard product made from a ceramics by vacuum evaporationo etc., for example. Moreover, by forming slot section 2e in the abbreviation center section of substrate 2c, the homogeneity of the size of the grounding field of the circumference of slot section 2e is carried out mostly, and stabilization of an electromagnetic-coupling property is attained.

[0025] Drawing 8 is ** type drawing of longitudinal section showing the 3rd example of MMIC package assembly concerning this invention. MMIC package assembly 20 shown in drawing 8 carries out sealing hold of MMIC2 into the metal package 30. A package 30 comes to carry out hermetic sealing of the metal lid 32 to the metal base 31. Slot section 31a which consists of plane view rectangle-like **** is formed in a base 31, and it is made to maintain the airtight in a package 30 by closing this slot section 31a with dielectric **** 33 made from a ceramic at it. and the base of dielectric **** 33 -- flat antenna 41e -- forming -- a flat antenna 41 -- microstrip-line 2f formed in the front-face side of e and MMIC2 -- slot section 31a -- minding -- electromagnetism -- it is made to join together-like Since the whole package 30 is metal, it can prevent effectively that an unnecessary RF signal is emitted from mixing and the interior of a package of an unnecessary signal.

[0026] Drawing 9 is a block block diagram of the radar module for mount constituted using MMIC package assembly concerning this invention. the grounding which base or top (you may be the side face) 60a of a package 60 equipped with slot section 60b -- a conductor -- the ceramic to which 60c was ****ed with the two-layer ceramic plates 60d and 60e, and other fields of a package 60 carried out the metal or the conductor layer for vacuum evaporationo etc. except for the fraction of each terminal block 60f, 60g, 60h, and 60i -- forming -- the whole of a package 60 -- electromagnetism -- it is considering as the structure

[0027] Inside the package 60, seal hold of MMIC70 which processes the RF signal of a several 10GHz band and which consists of a GaAs chip, for example, and analog to digital signal-processing IC80 which processes the signal of a frequency lower than a ********** band and which consists of an Si chip, for example is carried out. It is made to receive supply of power V+ of positive/negative, and V- through 60g of terminal block, and terminal-block 60i.

[0028] A flat antenna 63 is formed in the base [of a package 60], or superficies side of top (you may be the side face) 60a, and the microstrip line (micro stripe conductor) 64 is formed in a internal-surface-of-parietal-bone side.

[0029] Between a microstrip line 64 and the transmission-and-reception changeover means 71, it has connected by bonding wire 64a. It is good also as structure of forming a microstrip line 64 in a rear face at MMIC70, and connecting a microstrip line 64 and the transmission-and-reception changeover means 71 through the Bahia hall etc.

[0030] The transmission-and-reception changeover means 71 is constituted using a circulator circuit or a switching circuit. Input-signal 71a is amplified by the low noise amplifier 72, the signal component of a desired frequency band is extracted through a band-pass filter (BPF) 73, and intermediate-frequency-signal 74b which mixed with local oscillation signal 74a supplied from the exterior through 60f (external end-connection child) of terminal block with a mixer (mixer) 74, carried out frequency conversion, and was obtained is supplied to the intermediate frequency amplifying circuit 81 in analog to digital signal-processing IC80 (IF amplifying circuit).

[0031] In addition, slit combination is prepared in the 1 side face of a package 60, without preparing 60f (external end-connection child) of terminal block, and it may be made to supply local oscillation signal 74a in a package 60 by the electromagnetic coupling.

[0032] After amplifying intermediate-frequency-signal 74b by the intermediate frequency amplifying circuit 81, an input signal is analyzed by performing digital signal processing with the processing means 83 which changed into the digital intermediate frequency signal and was constituted from an A/D converter using the microprocessor, and it is made to output the distance information to a target etc. to the exterior as serial-data 83a.

[0033] Modulation command 83b outputted from the processing means 83 is changed into analog signal (for example, voltage signal) 84a which corresponds by D/A converter 84, the modulator 75 in MMIC70 is supplied, modulating-signal 75a is amplified by the high-frequency amplifier 76, after carrying out phase adjustment with the phase vessel 77, power amplification is carried out by the RF power amplifier 78, the microstrip line 64 for electric supply is excited through the transmission-and-reception changeover means 71, and it is made to emit a radar Hertzian wave from the flat antenna 63 through slot coupling.

[0034] Thus, the radar module for mount constituted using MMIC package assembly concerning invention is made to perform a reception of the rf radiation from a flat antenna 63, and a reflected wave using slot coupling. slot section 60b and each terminal block 60f, 60g, and 60h, and 60i fraction -- removing -- the whole of a package 60 -- electromagnetism -- since it is the structure to shield, an unnecessary RF signal can mix inside a package, or it can prevent effectively that an unnecessary RF signal is emitted out of a package out of a package

[0035] Drawing 10 is ** type drawing of longitudinal section showing the 4th example of MMIC package assembly concerning this invention. This MMIC package assembly 90 forms the microstrip line 91 for electric supply, and connects electrically between the output of this microstrip line 91 and MMIC92, or the input terminals 93 to the package internal-surface-of-parietal-bone side of dielectric plate (ceramic plate) 41a of the top which constitutes the base 41 of a package 3 by the bonding wire 94.

[0036] Although a high position precision is demanded in case of installation of MMIC2 in the case of the structure of preparing microstrip-line 2f for electric supply in the front face of MMIC2 as shown in drawing 1 , the installation precision of MMIC92 is eased with the structure shown in drawing 10 .

[0037] Drawing 11 is a perspective diagram by the side of the rear face of the package which shows the 5th example of MMIC package assembly concerning this invention. This MMIC package assembly 95 forms the microstrip line 96 for electric supply (RF signal-transmission line) which changed to the antenna (radiation conductor) and used slot coupling, and through this microstrip line 96, the RF signal from MMIC is supplied to other circuits, or it supplies the RF signals (for example, local oscillation signal etc.) from other circuits to the rear face (superficies) of a package 3 to MMIC in a package 3.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing of longitudinal section of MMIC package assembly concerning this invention
[Drawing 2] The perspective diagram of the status that the lid of a package was removed
[Drawing 3] The perspective diagram of terminal block
[Drawing 4] The perspective diagram which looked at the package from the rear-face side
[Drawing 5] Cross-section structural drawing of MMIC
[Drawing 6] ** type flat-surface explanatory drawing showing the physical relationship of a microstrip line, the slot section, and a flat antenna
[Drawing 7] ** type drawing of longitudinal section showing the 2nd example of MMIC package assembly concerning this invention
[Drawing 8] ** type drawing of longitudinal section showing the 3rd example of MMIC package assembly concerning this invention
[Drawing 9] The block block diagram of the radar module for mount constituted using MMIC package assembly concerning this invention
[Drawing 10] ** type drawing of longitudinal section showing the 4th example of MMIC package assembly concerning this invention
[Drawing 11] The perspective diagram by the side of the rear face of the package which shows the 5th example of MMIC package assembly concerning this invention
[Drawing 12] ** type structural drawing of the conventional slot coupling micro-stripe antenna
[Drawing 13] The cross section of other conventional microwave integrated circuits
[Description of Notations]
1, 10, 20, 90, 95 MMIC package assembly
2, 70, 92 MMIC (monolithic microwave integrated circuit)
2f, 64, 91 Microstrip line
3, 30, 60 Package
4, 31 Base
5, 32 Lid
41, 41S Base
41a, 41b, 60d, 60e Up-and-down dielectric plate (ceramic plate)
41c and 60c a grounding -- conductor
41d, 60b Slot section
41e, 63 Flat antenna (radiation conductor)
42 Frame
43, 60f, 60g, 60h, 60i Terminal block
96 Microstrip Line for Electric Supply (RF Signal-Transmission Line)

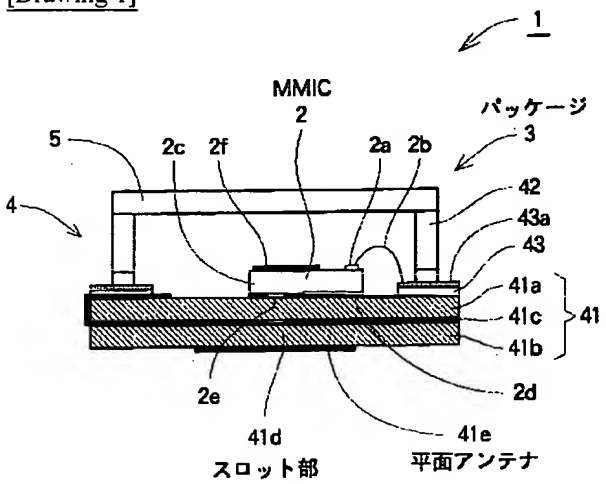
[Translation done.]

* NOTICES *

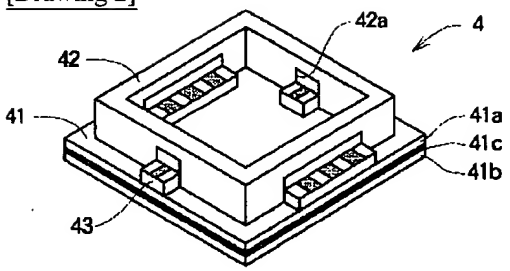
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

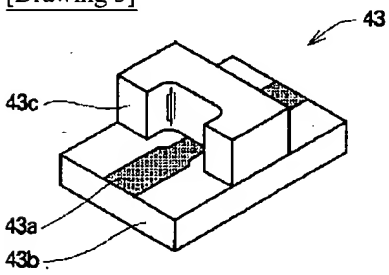
[Drawing 1]



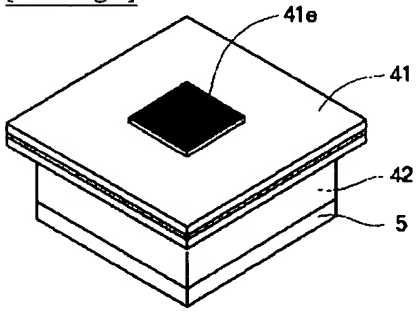
[Drawing 2]



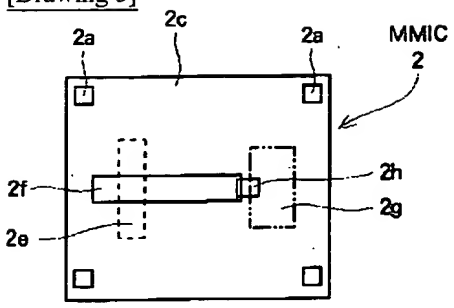
[Drawing 3]



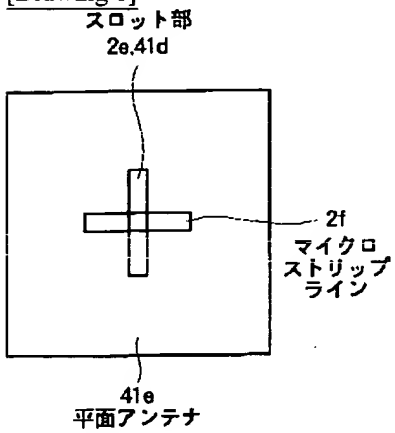
[Drawing 4]



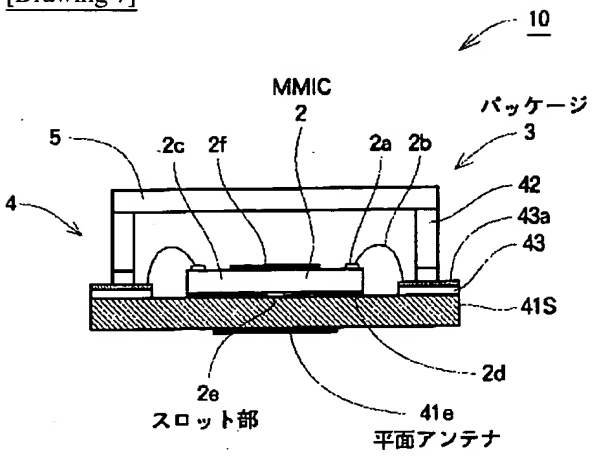
[Drawing 5]



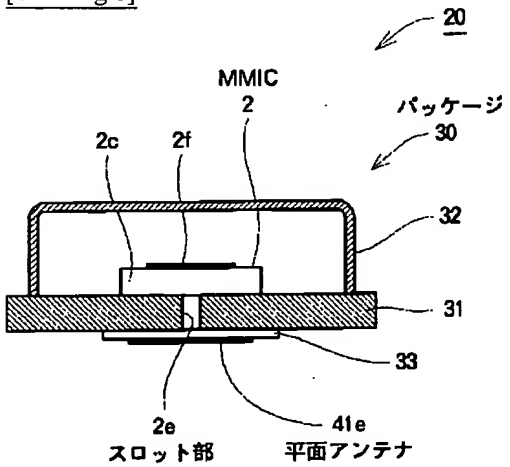
[Drawing 6]



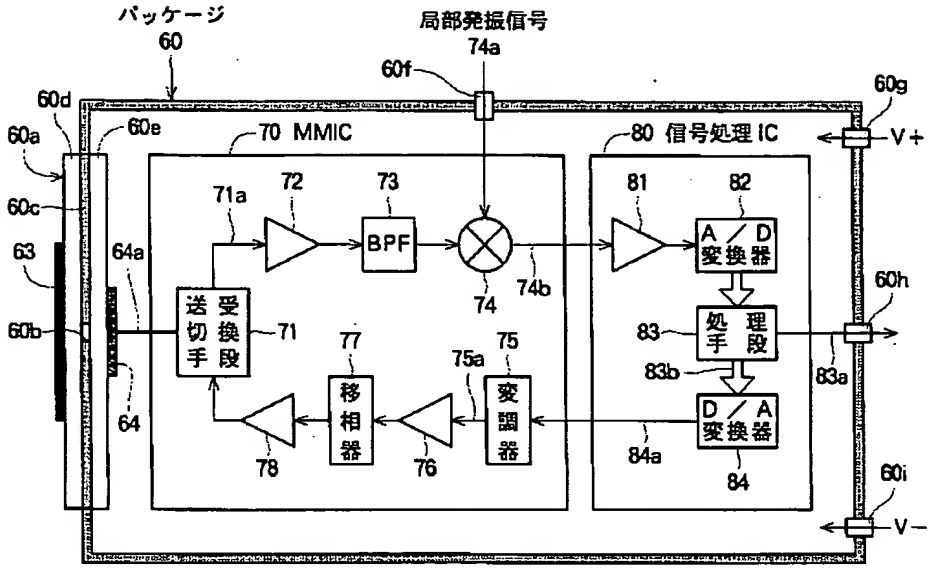
[Drawing 7]



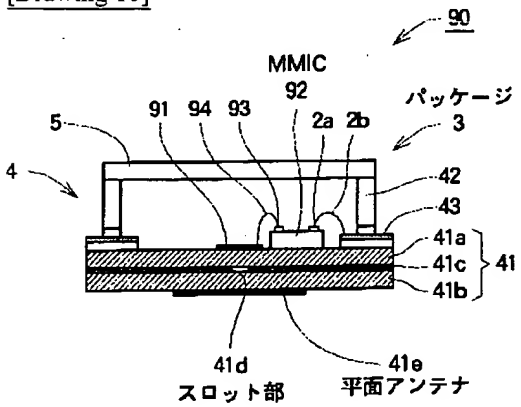
[Drawing 8]



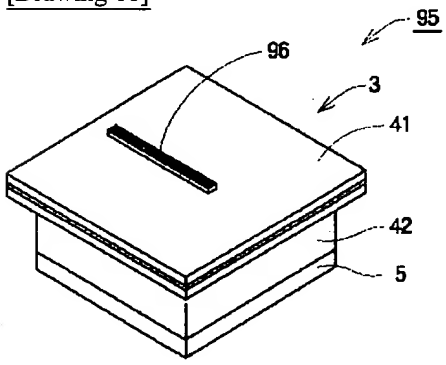
[Drawing 9]



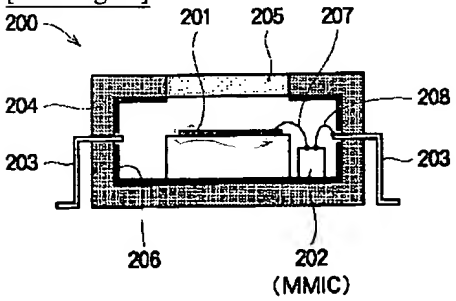
[Drawing 10]



[Drawing 11]

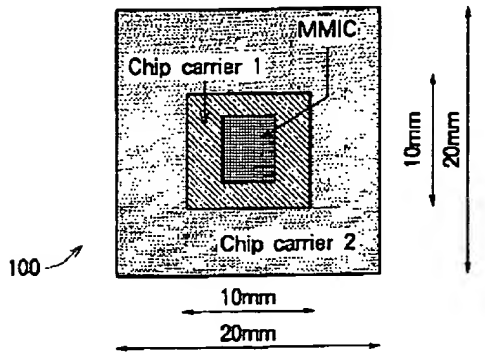


[Drawing 13]

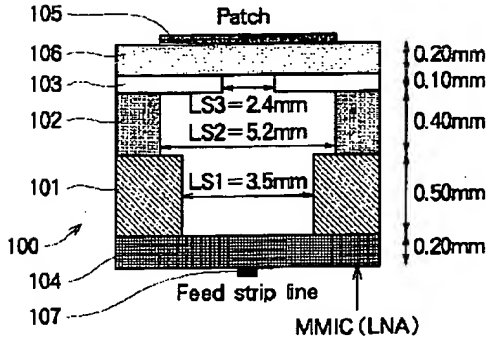


[Drawing 12]

(a) 裏面から見たMMICとチップキャリア



(b) スロット断面と基板の寸法



[Translation done.]